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Anatomical variation of the incisive canal: A CBCT study at Universitas Airlangga Academic Dental Hospital

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Abstract

Incisive canal located in maxillary anterior of hard palate around maxillary central incisor region that acts as a tunnel between the oral cavity and the nose. Incisive canal provide sensory innervation to the nasal septum and the anterior mucosa of the hard palate. The anatomical shape of the incisive canal varies individually, hence, should be considered before surgical intervention in the oral cavity. To determine the distribution of anatomical variations of the incisive canal in the sagittal section at Universitas Airlangga Academic Dental Hospital using Cone Beam Computed Tomography (CBCT). Fifty-four samples were obtained from the interpretation report of sagittal section of CBCT at Universitas Airlangga Academic Dental Hospital from 2015 – 2021. Observations of the incisive canals were carried out by agreement of authors by classifying the variations into cylindrical shape, funnel shape, banana shapes and hourglass shapes. In 54 samples with an age range of 12 - 70 years, the variations of the incisive canal were Cylindrical shape (63%), Banana shape (19%), Funnel shape (17%) and Hourglass shape (2%). Based on gender, Cylindrical shape was most commonly found in men (56%) and women (73%). Four variations of anatomical variations of the incisive canals were found at Universitas Airlangga Academic Dental Hospital, with cylindrical shape as the most prevalent variation. Therefore, observation of the incisive canal anatomy is necessary before surgical intervention.

Keywords: Anatomical variation; Incisive canal; Distribution; CBCT

1. Introduction

Radiographic examination is important to support diagnosis, evaluation, treatment plan, treatment procedures, prognosis, and patient education. Radiographic imaging provides information on the condition of objects that are not seen clinically. In the field of dentistry, high-resolution and detailed radiographic image quality is needed to determine the correct diagnosis in determining anatomy and abnormalities before surgery.[1]

The incisive canal is located anterior to the hard palate, precisely at the posterior of the incisor teeth and foramen is described as a funnel-shaped canal, the incisive canal has a role in connecting the oral cavity with the nose.[2,3] The incisive canal is traversed by the nasopalatine nerve and branches of the nasopalatine artery, which provide sensory innervation to the nasal septum and anterior mucosa of the hard palate and palatal gingiva of up to six anterior teeth.[4,5,6] The shape of the incisive canal variation on the sagittal section based on research by Linjawi, A. I., et al. classified as cylindrical shape, funnel shape, banana shape and hourglass shape.

Dentists should be aware of the incisive canal as well as its morphology before surgery.[7] Dental implant surgery requires detailed information about neurovascular containing structures, such as accessory canals, to avoid severe complications. The estimation of incisive canals and accessory canals as the two most vulnerable structures in the

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anterior maxilla, is useful in preventing complications that may occur during dental implant surgical treatment. When replacing a maxillary central incisor with a dental implant, there is a risk of the implant entering the nasal cavity or incisive canal thereby contact of the implant with existing neural tissue may result in failure of osseointegration, complications such as intraoperative bleeding, and postoperative sensory deficits.[7]

Current developments in radiographic technology are able to provide more accurate and detailed information regarding oral manifestations. Cone beam computerized tomography (CBCT) is one of the most accurate radiographic techniques for three-dimensional imaging of hard tissue with minimal distortion and reduced radiation risk.[8] CBCT can produce three-dimensional images covering the axial, coronal and sagittal planes.[9]

The sagittal plane of the incisive canal can be used to assess the shape of the canal, the curvature of the canal, the angle of curvature and the length of the canal.[10] The CBCT imaging method in the sagittal plane can evaluate the incisive canal clearly in view of variations in cylindrical shape, funnel shape, banana shape and hourglass shape.[11] Therefore, in this study, anatomical observations of the incisive canal were carried out on sagittal CBCT radiographic sections.

The anatomical characteristics of the incisive canal can be observed through CBCT views and intraoral radiographs. The incisive canals can be seen in intraoral radiographic projections of the maxillary incisor anatomy, especially when a vertical angle is used. To see the anatomical variations of the incisive canal on sagittal sections, CBCT is the best image to evaluate the incisive canal which provides high-resolution images and can clearly see variations in cylindrical shape, funnel shape, banana shape and hourglass shape.[11]

Based on the description above, it is very important to know the anatomical variations of the incisive canal on sagittal sections using CBCT which has never been done at Universitas Airlangga Academic Dental Hospital. Apart from being a reference in the treatment of maxillary incisor dental implants, this study aims to determine the distribution of anatomical variations of the incisive canals at Universitas Airlangga Academic Dental Hospital.

2. Material and methods

This study uses a type of descriptive observational research. This research has obtained ethical approval from the Universitas Airlangga Dental Hospital Ethical Committee, with certificate number 33/UN3.9.3/Etik/PT/2022. This study used secondary data (soft files) CBCT readings from dentistry radiologists from patients at Universitas Airlangga Academic Dental Hospital in the period 2015 – 2021. The sample criteria used were readings from patient's CBCT imaging of the anterior maxilla. This research was conducted at the Radiology Installation Universitas Airlangga Academic Dental Hospital, with a period from June to September 2022. Sampling in this study was carried out using a purposive sampling method.

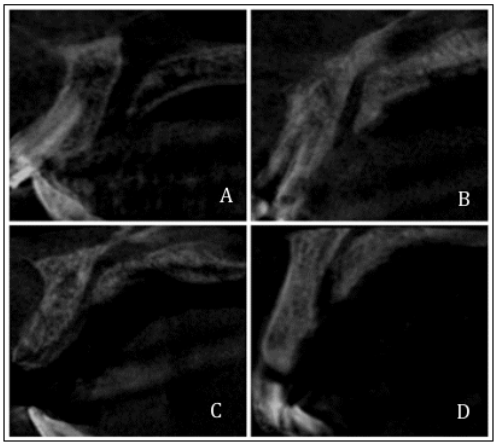

Figure 1 Incisive canal shapes from a sagittal reconstruction. (a) *Cylindrical shape*, (b) *Funnel shape*, (c) *Banana shape*, (d) *Hourglass shape*

The inclusion criteria used were readings from the patient's CBCT imaging on the anterior maxilla. Exclusion criteria consisted of unclear imaging such as the presence of artefacts, the presence of impacted teeth in the anterior maxilla, the presence of suspected pathology in the anterior maxilla. The data analyzed in this study was to calculate the percentage of anatomical variations of the incisive canals. The distribution of anatomic variations of the incisive canal will be calculated based on age and sex groups. The data was tested by reliability testing using the Intraclass Correlation Coefficient (ICC). This observation was carried out by 2 observers, namely the supervising lecturer. Laptop refers to the type of technology used during the observation. The anatomical variations of the incisive canal are divided into 4 variations, namely, cylindrical shape, funnel shape, banana shape and hourglass shape. (Figure 1).

3. Results

Based on the results of the reliability test with ICC on the anatomical variations of the incisive canal data on the CBCT sagittal section performed using IBM SPSS version 26, the average measures value was 0.78. The results of the reliability test with ICC are stated to be high or close to 1.

There were 54 CBCT secondary data (soft files) with an age range of 12-70 years. The most common incisive canal anatomical variations found were 34 (63%) cylindrical shapes, 10 (19%) banana shapes, 9 (17) funnel shapes. %) and Hourglass shape by 1 (2%) (Table 1). Each of the anatomic variations of the incisive canal has a meaning, that is, the cylindrical shape shows the labial and palatal walls of the parallel canal. The funnel shape shows the anteroposterior dimension of the canal rising from the nasal fossa to the hard palate. Banana shape shows the anteroposterior dimension forming an arc towards the nasal fossa. The hourglass shape shows the narrowest anteroposterior dimension at the mid-level of the canal compared to the dimensions at the nasal and palatal levels. There were 54 CBCT secondary data (soft files) with an age range of 12-70 years. The most common incisive canal anatomical variations found were 34 (63%) cylindrical shapes, 10 (19%) banana shapes, 9 (17) funnel shapes. %) and Hourglass shape by 1 (2%). Each of the anatomic variations of the incisive canal has a meaning, that is, the cylindrical shape shows the labial and palatal walls of the parallel canal. The funnel shape shows the anteroposterior dimension of the canal rising from the nasal fossa to the hard palate. Banana shape shows the anteroposterior dimension forming an arc towards the nasal fossa. The hourglass shape shows the narrowest anteroposterior dimension at the mid-level of the canal compared to the dimensions at the nasal and palatal levels.

Table 1 Distribution of incisive canal shapes

Variations	Total	Percentage (%)
Cylindrical Shape	34	63%
Funnel Shape	9	17%
Banana Shape	10	19%
Hourglass Shape	1	2%
Total	54	100%

4. Discussion

The anatomy of the incisive canal has a vital role connecting the oral cavity to the nose, and the incisive canal provides sensory innervation to the nasal septum and anterior mucosa of the hard palate.[12] The incisive canal anatomy in the sagittal section has classifications such as cylindrical shape, funnel shape, banana shape and hourglass shape.[2] In CBCT radiographic imaging in a sagittal section, the anatomy of the incisive canal can be clearly seen and can be used to assess the shape of the canal, the curvature of the canal, the angle of curvature and the length of the canal.[10]

There were 54 secondary CBCT radiographic data samples with an age range of 12-70 years consisting of 34 (63%) cylindrical shapes, 10 (19%) banana shapes, 9 (17%) funnel shapes and 1 (2%) Hourglass shapes. In the study of Kajan et al. there were 198 individuals of the Iranian population, the cylindrical shape was the most common. In a study by Fukuda et al. 20 samples of dentulous human maxilla and 20 samples of edentulous maxilla taken from dry adult skull bones. Results obtained in sagittal sections are the most common funnel-shaped. It was also found in Görürgöz & Öztaş's research, it was found that the funnel shape was the most common formation, followed by the second most hourglass shape. The prevalence of this anatomical variation of the incisive canal was found to vary among races and ethnicities.[2,13]

The anatomical shape of the incisive canal varies so that the anatomical structure, especially the maxillary anterior region, is taken into consideration before surgical treatment is carried out in the oral cavity.[11] Because the anterior maxilla prioritizes high esthetics.[14] If incisive canal perforation is found, a different surgical technique plan is needed before surgical treatment is carried out. Given the potential for complications in surgical treatment, dental implant treatment, it is necessary to evaluate the shape and dimensions of the incisive canal.[15] Dental implant surgery requires detailed information about neurovascular containing structures, such as accessory canals, to avoid severe complications. The presence of accessory canals is often overlooked or misdiagnosed, and damage to these structures during implant placement can lead to complications such as non-integrated dental implants, mucosal necrosis, paresthesias, bleeding, burning sensation in the occipital region, and neuropathy. The estimation of incisive canals and accessory canals as the two most vulnerable structures in the anterior maxilla, is useful in preventing complications that may occur during dental implant surgical treatment. There is one variation that has a closer distance to the accessory canals, namely the banana shape variation. Banana shape variations are predicted to have a high risk of perforation of the accessory canals in dental implant surgery.[7]

5. Conclusion

In accordance with the results of research obtained by observers that found various forms of anatomical variations of the incisor canal at Universitas Airlangga Academic Dental Hospital. So it is important to recognize variations in the anatomy of the incisor canal as an additional educational and action requirement at Universitas Airlangga Academic Dental Hospital. The obstacle in this observation was the limited secondary data included in the sample criteria at Universitas Airlangga Academic Dental Hospital so that they could not describe the representative variations of cylindrical shape, funnel shape, banana shape and hourglass shape in this study.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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